

EXCELLENT REPORT

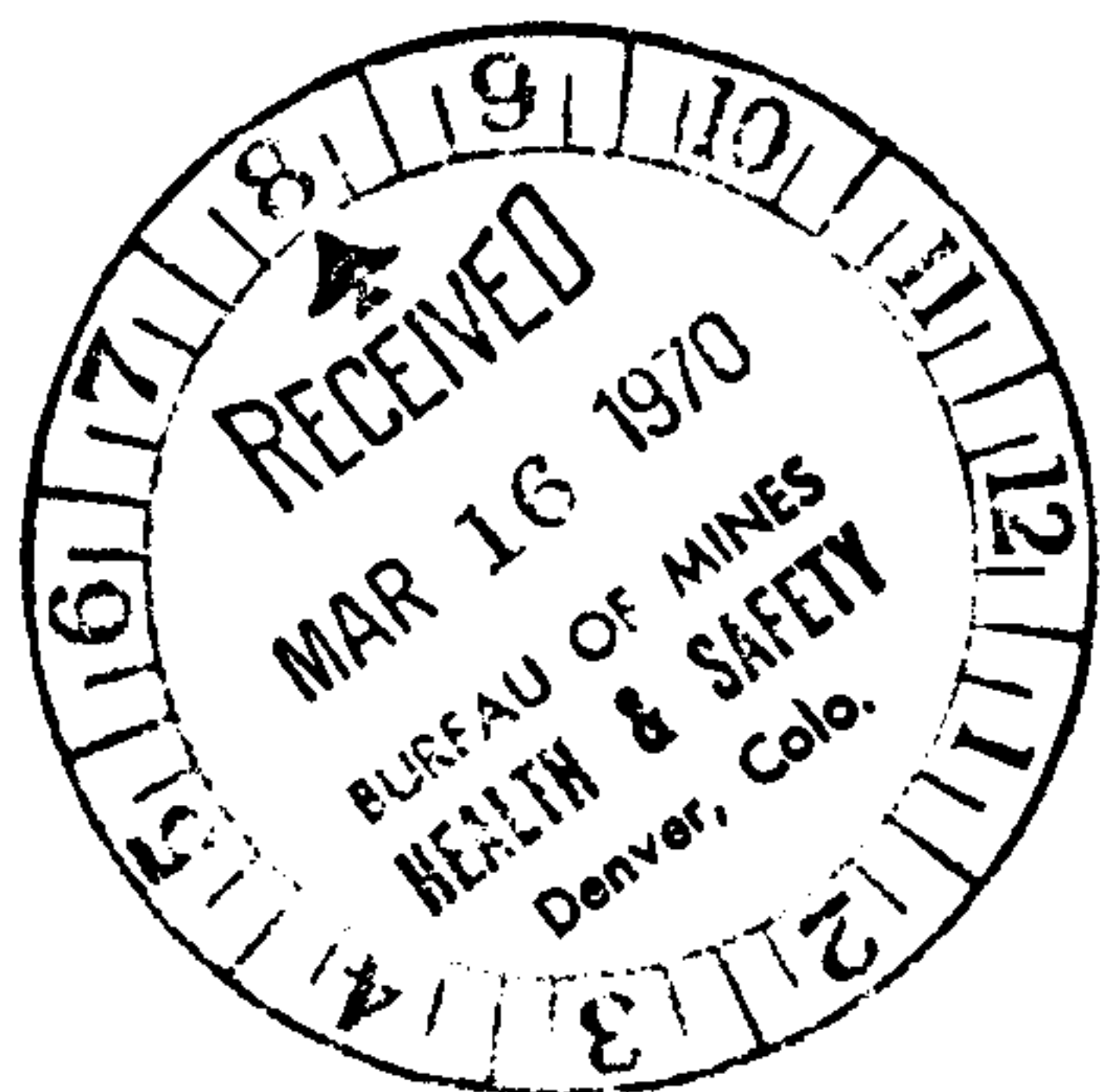
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# COAL NONFATAL

UNITED STATES  
DEPARTMENT OF THE INTERIOR  
BUREAU OF MINES

70-0278

DISTRICT C



FINAL REPORT OF NONFATAL COAL-MINE BUMP ACCIDENT  
NO. D-1 MINE  
WISCONSIN STEEL COAL MINES  
INTERNATIONAL HARVESTER COMPANY  
BENHAM, HARLAN COUNTY, KENTUCKY

February 10, 1970

by

J. L. Gilley  
Mining Engineer

Originating Office - Bureau of Mines  
Norton, Virginia 24273  
J. S. Malesky, District Manager  
Coal Mine Safety District C

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INTRODUCTION

This report is based on an investigation made in accordance with the provisions of the Federal Coal Mine Safety Act (66 Stat. 692; 30 U.S.C. Secs. 451-483) as amended.

A coal-mine outburst (bump) occurred in the No. 3 entry and crosscut to the right off No. 3 entry in the main face development in the D-1 Mine at 12:05 p.m., February 10, 1970, resulting in injuries to Walter Rogers, continuous miner operator; Vernon Cornett, shuttle-car operator; and Ronald Boggs, continuous miner operator's helper. Eleven other employees, including two section foremen, on the section at the time of the outburst, were not injured, and they assisted with the rescue of and administered first-aid to the injured workmen who subsequently were taken to the hospital at Benham, Kentucky, for examination and treatment. Rogers, age 37, with 17 years experience, received complete fracture of the right femur, multiple fractures of the transverse process on right side, and contusions and bruises. Cornett, age 25, with 4 years mining experience, received fracture of the upper one-third of the left fibula, hairline fracture of right scapula and contusions and abrasions about the head and trunk region; and Boggs, 28 years old, with 3 years mining experience received small contusions from flying coal particles, and after examination at the hospital, was released and returned to work without lost-time.

A company official notified the writer, who was in the Norton office, at 5:08 p.m., on the day of the occurrence; an investigation was started the following day and was concluded February 12, 1970.

Related data on conditions and sequence of events prior to the outburst and operational procedures in progress at the time of the occurrence, were obtained from statements of witnesses and by detailed examinations of the section involved, which, with the exception of the removal of

equipment, remained undisturbed. The mined areas, in the subjacent "B" and "C" coalbeds situated directly under the scene of the outburst in the "D" coalbed, were not accessible for inspection, but mine maps of these areas and logs of boreholes nearest the scene of the outburst were examined.

#### GENERAL INFORMATION

The No. D-1 Mine at Benham, Harlan County, Kentucky, on State Highway 160, is operated through drifts in the high-volatile "D" coalbed, which ranges from 35 to 48 inches in thickness in current working areas; the height of the coal averaged 44 inches in the vicinity of the outburst. The coal, although structurally strong, is brittle and shatters under sudden stress or blow. The face-and-butt cleavage planes of the coal are very distinct.

The mine was opened September 16, 1969, and a total of 30 men, 28 underground and 2 on the surface, is employed on a triple-shift basis, 5 days a week, and produces an average of 1,400 tons of coal with two Lee-Norse CM-32 type continuous mining machines. Coal is transported by shuttle cars from working faces, thence to the surface by rubber-belt conveyor.

The D-2 Mine was in the process of development by a multiple-entry system with main entries projected 7 abreast and the cross or face entries projected to be driven 5 abreast. Entries were on 60-foot centers and 18 feet in width with crosscuts turned at 90 degrees off the entries at 65-foot intervals. At the time of the bump, the main face entries had advanced a maximum of 2,980 linear feet from the surface; 1,700 feet of which extended into a recently acquired boundary of coal overlying mined-out workings in the "B" and "C" coalbeds. Pillar extraction by a partial mining method was planned subsequent to completion of the main face entry development. The life expectancy of the mine was estimated to be about 4 years by the chief engineer.

The D-1 Mine is near the center of the Cumberland Gap coalfield, which occupies a northeasterly-trending synclinal basin nearly 90 miles long and 15 to 20 miles wide, bounded by the Pine Mountain Ridge on the northwest and the Cumberland Mountain Ridge on the southeast. The irregular crests of the Black Mountain within the property have elevations in excess of 3,800 feet; the maximum depth of cover encountered on the property is approximately 2,000 feet. The depth of cover over the main face entries in the No. D-1 Mine (scene at outburst) ranges from 1,250 to 1,400 feet.

The immediate and the main roof overlying the portion of the "B" or Marker coalbed underlying the scene of the bump in the "D" coalbed, consists of dark gray shales 30 to 34 feet in thickness.



The immediate roof overlying the "C" or Kellioke coalbed, comprises 3 to 10 feet of gray shales overlain by sandstone strata 60 to 65 feet thick.

The immediate roof overlying the "D" coalbed consists of sandy shale in excess of 5 feet in thickness overlain by several stratum of sandstone that ranges from a few feet to more than 90 feet in thickness.

The immediate floor underlying the 4 coalbeds ("A" "B" "C" and "D") on this property consists of shales that vary from 2 to 12 feet in thickness. The immediate floor under the "D"-1 main face development is a dense, hard, but loosely consolidated sandy shale extending to a depth of about 5 feet, which resists plastic flow, but does heave readily when subjected to excessive pressure. Very little heaving of the floor was in evidence in the area prior to the outburst, but after the occurrence, progressive convergence was evident; the height between the floor and roof at the scene of burst, had decreased from 44 to 36 inches in the No. 3 entry.

Roof support in the development entries consisted of roof bolts, 5/8-inch in diameter, 36-inch minimum length, installed on 4-foot centers in accordance with Bureau approval. Supplementary support along each side of the conveyor belts was provided with posts and with three-piece timber sets, where conditions required.

Coal outbursts of considerable magnitude have occurred in the "A", "B", and "C" coalbeds but the only outburst, of consequence according to company records, to occur previously in the "D" coalbed was in August 1963. Natural conditions in these coalbeds primarily favor the liability of occurrence of bumps, and unquestionably, the present multiple-seam mining, whether done simultaneously or consecutively, influence the chance of their occurring; numerous unmapped isolated pillars in parts of the mines increase the bump potential.

Persons interrogated and who furnished information during this investigation include:

J. R. Williams  
M. Palmer  
Kenneth Dixon  
William M. Prewitt  
James Estep  
J. H. Patton  
Delza Adams  
Ronald Boggs  
Gary Creech  
Dean Adams  
Kyle Sturgill

Chief Engineer  
Mining Engineer  
General Mine Foreman  
Mine Foreman (Day)  
Mine Foreman (Evening Shift)  
Mine Foreman (Midnight Shift)  
Assistant Foreman (Day Shift)  
Continuous Miner Operator's Helper  
Continuous Miner Operator (Day Shift)  
Roof Bolter  
Continuous Miner Operator (Midnight Shift)

The investigating committee consisted of:

Company Officials

B. E. Caudill	Superintendent of Mining
J. R. Williams	Chief Engineer
Kenneth Dixon	General Mine Foreman
E. L. Kirk	Safety Supervisor
William M. Prewitt	Mine Foreman
Delza Adams	Assistant Foreman

Progressive Mine Workers of America

Ronald Boggs	Continuous Miner Operator's Helper
Dean Adams	Roof Bolter

United States Bureau of Mines

J. L. Gilley	Mining Engineer
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The last Federal inspection of the mine was completed November 4, 1969.

DESCRIPTION OF OCCURRENCE

On the day of the outburst, the main face entry day-shift crew, consisting of 12 workmen and 2 foremen, arrived on the section about 8:15 a.m., and after examination of the face regions, the foreman assigned specific duties to members of the crew. Normal mining operations were started soon thereafter, and continued until the outburst occurred at 12:05 p.m.

Two Lee-Norse 32 CM-type continuous miners were utilized in developing the 7 main face entries. The No. 1 unit miner normally operated in the Nos. 1, 2, and 3 entries and the No. 2 unit miner in the Nos. 5, 6, and 7 entries; development of the No. 4 entry was with the Nos. 1 and 2 unit miners operating alternately, to keep this entry abreast with the collateral entries. Sketch No. 2 indicates the extent of development of the main face entries at the time of the outburst February 10, 1970.

On the day of the coal outburst, the mining cycle with the No. 1 unit started in the crosscut between Nos. 2 and 3 entries. The face of the No. 2 entry was idle the two previous shifts because of adverse roof conditions. The cycle of mining with the No. 1 unit, up until the time of the bump, was conducted alternately in the inby crosscuts to the right and left off the No. 3 main face entry; the first and third mining cycles were in the crosscut to the left; and the second mining cycle with this



unit, was in starting the crosscut to the right in the No. 3 entry and the fourth mining cycle was in progress in this crosscut. The face of this crosscut was advanced 32 feet from the center line of the No. 3 entry when the bump occurred, and about 10 feet of this distance was mined during the cycle, immediately prior to the bump.

Mining on the right side of the section was confined to advancing the faces of the Nos. 6 and 7 entries, and the miner was at the face of No. 6 entry, but was not operating, at the time the bump occurred. Mining on the right side had been curtailed because of a mechanical failure of one of the shuttle cars, and the other shuttle car was discharging coal at the transfer terminal or loading point.

After completing the mining cycle (third cycle) in the crosscut connecting the Nos. 2 and 3 entries, Walter Rogers, the No. 1 unit miner-operator, moved the miner into the crosscut to the right in No. 3 entry at about 11:20 a.m., and went to eat lunch. Ronald Boggs, miner-operator (helper) relieved Rogers and started mining coal. William Prewitt, mine foreman, remained in the place and observed the mining operations until Rogers, the miner-operator, returned from lunch at 12:00 noon. Prewitt then left to examine conditions in the crosscut to the left off No. 3 entry where ~~\*~~Dean Adams, roof bolter, was installing roof bolts. Prewitt stated that a very short time after he arrived in the crosscut, there was an unusually loud report accompanied by a very strong wind blast or stress wave, which threw him and Adams to the mine floor and stunned them momentarily. A very dense cloud of dust was thrown into suspension, and reportedly, the roof and floor "worked" extensively throughout the face area, and for a distance of about 200 feet outby the scene of the burst. After the dust settled to permit visibility, the foremen and the uninjured workmen, some of whom are well trained in first-aid methods proceeded to the No. 3 entry to locate and rescue the 3 injured men. Vernon Cornett, shuttle car operator, was found semi-conscious and injured, in the roadway about 8 feet outby the shuttle car. Walter Rogers, who was acting as the miner-operator helper, had checked the position of the miner cable, then positioned himself between the right rib line and the shuttle car which was being loaded. Rogers was found semi-conscious and injured lying against the right front wheel of the shuttle car and partially covered with coal expelled from the No. 3 entry chain pillar. Boggs, who was operating the continuous miner at the time the bump occurred, escaped injury, and crawled between the miner and the rear end of the shuttle car, thence, outby the scene of the outburst. After ascertaining that Rogers and Cornett had sustained various injuries and were conscious, they were moved to a safe location outby and were given first-aid, transported to the surface where they were examined by a doctor then were taken to a hospital in Benham, Kentucky.

The outburst was violent in nature in that a considerable amount of coal was expelled forcefully from 3 sides of the pillar between the Nos. 3 and 4 entries and from the adjacent ribs in the No. 4 entry, as indicated in Sketch No. 1. Voids 6 to 12 inches in height and extending as much as 15 feet over the pillars, were formed by displacement of the coal and the No. 4 entry roadway was nearly closed by pulverized coal. Coal also was shaken from ribs and face of the No. 3 entry and from the ribs of 4 pillars nearest the scene of the outburst. The reversal of strain or rebound in connection with the outburst fractured the roof at 3 locations, and pronounced heaving of floor and convergence occurred at the respective locations indicated in Sketch No. 2. A small section of roof was shaken down between the roof bolts and left rib near the face of No. 3 entry. Reportedly, the only damage to equipment was a broken hydraulic pressure-line connection on the continuous miner.

Location of men and equipment directly involved in the outburst and the extent of the outburst area are indicated in detail in Sketch No. 1. The active area, extent of development and correlation of the D-1 Mine entry development with the relative projections of large unmined pillars and mined areas in the subjacent "B" and "C" coalbeds are indicated in Sketch No. 2.

Information obtained during this investigation revealed that the first manifestations of the impending stressed condition in the main face development were observed during the 12:01 to 8:00 a.m. shift, February 6, 1970. James Estep, evening-shift mine foreman, stated that the stress-relief noises, normally experienced during mining with the continuous miners in the area, started increasing in frequency and in amplitude, especially in the Nos. 2, 3, and 4 entries. The main face entry advancement, at this time, started to the rise on about a 2 percent grade. Then on the 12:01 to 8:00 a.m. shift, February 9, reportedly, the roof in the face regions of the Nos. 2 and 3 entries fractured and became "drummy". Conditions reportedly were good in Nos. 4, 5, 6, and 7 entries at this time. Mine foreman, Prewitt, stated that the coal seemed to be softer during the day shift, February 9, than on his previous shift of February 6, and that the Nos. 2, 3, and 4 entries continued to the rise. James Estep, the evening-shift foreman, related that during the early part of the evening shift February 9, stress-relief noises increased in amplitude and the localized coal disruptions during mining operations in the Nos. 3 and 4 entries occurred with more force than previously, but conditions in the Nos. 5, 6, and 7 entries seemed to be normal. Prewitt, reported that no unusual bumping occurred during his shift on February 10, prior to the bump at 12:05 p.m.

Current mining in the D-1 Mine was confined to a boundary of coal recently acquired by the International Harvester Company from an adjoining coal company. Reportedly, and according to the mine map, the "D" coalbed had



not been mined, but the subjacent "C" or Kellioke coalbed had been mined extensively during the last 50 years and partial mining had been done in the subjacent "B" or Marker coalbed. The interval between the "D" and the "C" coalbeds in the vicinity of the outburst, was 75 feet and the thickness of the interval between the "C" and the "B" coalbeds was 30 feet. The cover overlying the scene of the accident was 1,350 feet.

The company did not possess a mine map of the workings in the newly acquired boundary of coal in the underlying "B" coalbed, and the map of the corresponding mined-out area in the subjacent "C" coalbed, in the company's engineering office, indicated complete extraction, which seemed doubtful in view of the distinctive circumstances under which the outburst occurred in the D-1 Mine. Therefore, it was expedient that accurate and up-to-date maps, showing the pertinent mine workings in the subject "B" and "C" coalbeds be obtained which was done by the chief engineer from the original owners of the property for this investigation.

Examinations of maps incorporating the area involved in the outburst in the D-1 Mine and the corresponding workings in the subjacent "B" and "C" coalbeds, revealed that the angle of projection for the main face entries in the D-1 Mine advertently put this development on a course to pass directly over an unmined portion of a barrier pillar, ranging from 170 to 210 feet in length and 190 feet wide and an adjacent chain pillar, 210 feet in length and ranging from 40 to 65 feet in width, in the "C" coalbed. Sketch No. 2 indicates the relative positions of the main face entries in the D-1 Mine and the isolated pillars, which formed an island abutment, in the mined-out "C" coalbed. From Sketch No. 2, it was noted that the faces of Nos. 3 and 4 entries had advanced about 65 feet over the front edge of this unmined barrier pillar, and that the Nos. 1 and 2 entries of 1 face left off 1 right 7 left in the "B" coalbed terminated under this barrier pillar at a location corresponding very closely to the face regions of the Nos. 3 and 4 entries involved in the outburst in the vertically-adjacent "D" coalbed. The isolated pillars in the "C" coalbed were abandoned in 1925, and the 1 face left entries in the "B" coalbed were abandoned in 1944.

The areas of maximum disturbance encountered was in the vicinity of the accident; however, the line of disturbance was first encountered about 120 feet outby the face of the No. 3 entry and in the other entries at the general locations indicated in Sketch No. 2. The type of relative displacement entailed a gradual bending upward of the coalbed and adjacent strata, horizontally, rather than by abrupt vertical displacement. This bending action was accompanied by distinct induced fracturing of the roof

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at three locations. Normally, the coal ribs in the "D" coalbed remain firm a long period after development, but in the disturbed area, some sloughing of the coal ribs was evident.

Reactions such as increased intensity of stress-relief noises, increased frequency of coal disrupting during the mining cycles and the difference in the degree of hardness of the coalbed in the area, provided clues to the impending highly-stressed area. These manifestations caused some apprehension among various crew members, and during the 4:00 to 12:00 p.m. shift February 9, production of coal was stopped for a period, to discuss and evaluate conditions.

Following the outburst, development of the main face entries was stopped and the equipment was removed. After completion of the investigation, a group of 5 entries, 18 feet in width on 60-foot centers was turned about 240 feet outby the scene of the outburst and coal production was resumed February 12.

A coal-mine outburst or bump is a cumulative process which manifests itself in one or more ways, but unfortunately its manifestations are not always recognized in time. It is evident that a combination of natural conditions favorable for outbursts exist in certain areas of the D-1 Mine and the 3 subjacent mines on this property. Therefore, where mining is done in the presence of this combination, every precaution must be taken to avoid, insofar as possible, critical areas and circumstances that could induce bumps, through proper mining methods and practices. Isolated pillars abandoned in an underlying or overlying coalbed can, and usually do, cause severe damage in the adjacent beds, and this has been the experience on several occasions in the mines on this property and in multiple-seam operations elsewhere. Unfortunately, no preventive measures can be taken to avoid this disturbance if a lower coalbed has been mined at some previous date, other than to anticipate and be prepared for the disturbance in mining the superjacent coalbed.

#### CAUSE OF COAL OUTBURST

From the foregoing description of the relationship of overburden, interval and nature of overburden, and the proximity of the two underlying coalbeds, the outburst resulted from the additive effects of superimposed abutment loads too great for the main face entry pillars to withstand. The consequent distortion and the concentration (impingement) of stresses in the main face entry development are attributed to previous mining in the subjacent "B" and "C" coalbeds, especially the area in the "C" coalbed containing the large abandoned coal pillars underlying the recently acquired boundary of coal in the D-1 Mine workings. Other factors involved include: The course for the main face entries was projected on

the basis of information from a mine map that indicated complete mining in the portion of the "C" coalbed underlying the recently acquired boundary of coal in the D-1 Mine. The mine officials were unaware of the presence of the unmined pillars in the "C" coalbed (and in the "B" bed) until the start of the investigation when additional mine maps were obtained by request and then examined; the fact that an employee positioned himself in a potentially dangerous location in an area conducive to outburst, contributed to the seriousness of the accident.

#### RECOMMENDATIONS

Compliance with the following recommendations may prevent accidents of a similar nature in the future:

1. The plans for current and future mining should take into consideration the degree to which the effects of previous mining in contiguous coalbeds will contribute to potential outbursts in the coalbed being worked, in this case the "D" coalbed.
2. The mining plans for the D-1 Mine should not incorporate areas in the subjacent "C" coalbed where, from past experience, manifestations indicate areas of high stress and distortion from processes of subsidence in the lower beds.
3. The mine maps of the vertically adjacent mine workings on this property or the maps of any workings in adjoining mines or any parts of the mines acquired for production of coal, should be accurate and up-to-date. Such maps should show all pillared, worked-out and abandoned areas, in the subjacent and in the superjacent coalbeds.
4. Every means should be taken to properly impress upon employees, the dangers of unnecessarily positioning themselves between the coal ribs and equipment especially in areas prone to outburst.

#### ACKNOWLEDGMENT

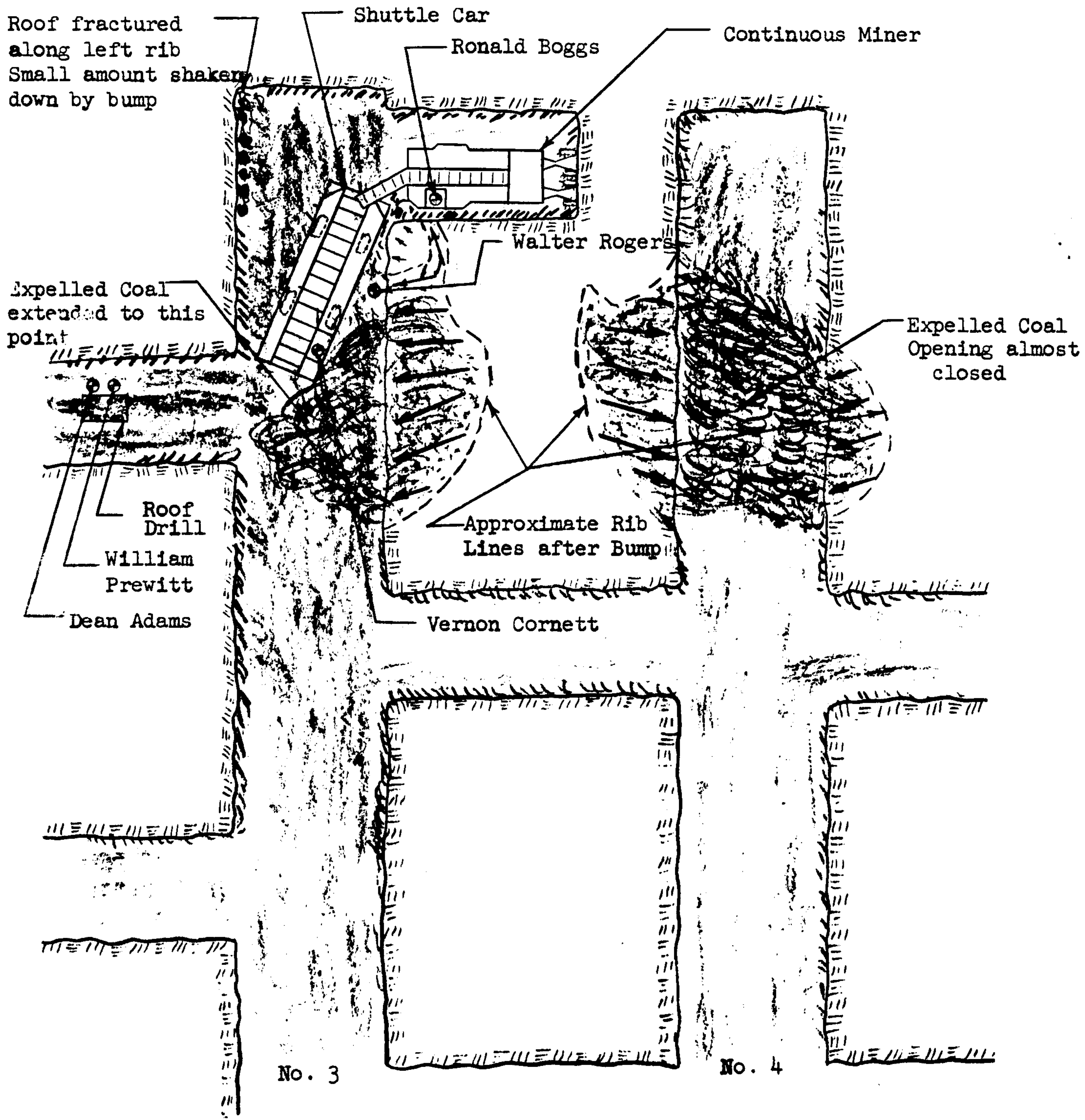
The cooperation of company officials and members of the Progressive Mine Workers of America during this investigation is gratefully acknowledged.

Respectfully submitted,

/s/ J. L. Gilley

J. L. Gilley  
Mining Engineer





SKETCH NO. 1

LEGEND

Shaded Area indicates convergence

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February 10, 1970

SCALE: 1" = 20'

Elevation "D" coalbed - 1,810'  
 Elevation "C" coalbed - 1,738'  
 Elevation "B" coalbed - 1,709'

LEGEND:

- Outline of portion of unmined barrier pillar in the subjacent "C" coalbed
- ..... Outline of extent of mining in the subjacent "B" coalbed
- XXXXXX Induced fractures in roof
- ///≡///≡///≡ Outby extent of convergence which increased progressively toward the face

Continuous Miner No. 1  
 Shuttle Car

Roof Drill

Continuous Miner No. 2

Roof Drill  
 (Inoperative)

Roof Fall  
 24" Thick  
 Cleaned up  
 prior to Outburst

Evidence of unmined  
 coal in subjacent bed in  
 this vicinity

SKETCH NO. 2

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SCALE 1" = 100'